US007156673B2

(12) **United States Patent**
Son

(10) **Patent No.: US 7,156,673 B2**
(45) **Date of Patent: Jan. 2, 2007**

(54) **APPARATUS FOR CONNECTING TO AN ELECTRICAL SOURCE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **11/184,384**

(22) Filed: **Jul. 18, 2005**

(65) **Prior Publication Data**

US 2006/0019519 A1 Jan. 26, 2006

(30) **Foreign Application Priority Data**

Jul. 20, 2004 (KR) 10-2004-0056560

(51) **Int. Cl.**
H01R 13/44 (2006.01)

(52) **U.S. Cl.** **439/131**; 439/640

(58) **Field of Classification Search** 439/131, 439/172, 173, 174, 518, 640
See application file for complete search history.

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(57) **ABSTRACT**

An apparatus is disclosed for connecting a power supply to an electronic device. The apparatus comprises a first case having an insertion opening and a plurality of terminal-receiving grooves extending outwardly from an inner circumference of the insertion opening. A second case is coupled to the first case to form a receiving space. A rotary member is rotatably inserted in the insertion opening and having slots formed on at least one surface to align with the terminal-receiving grooves of the first case when the rotary member is turned in a first direction in a predetermined angle. A plug terminal assembly installed in the rotary member. In a first state, the plug terminal assembly is positioned approximately vertically upward. In a second state, the plug terminal assembly collapses to an approximately horizontal position.

24 Claims, 7 Drawing Sheets

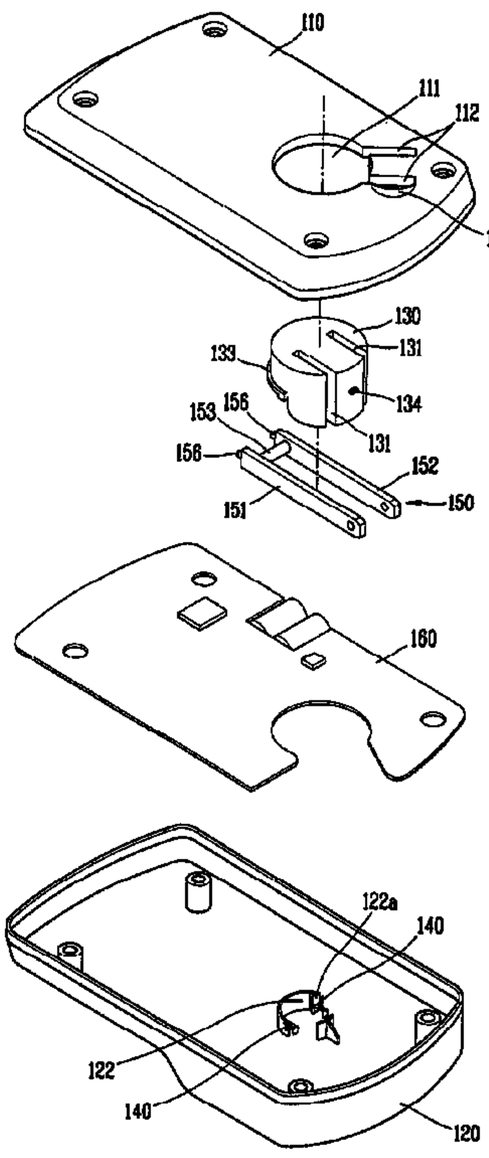


FIG. 1
RELATED ART

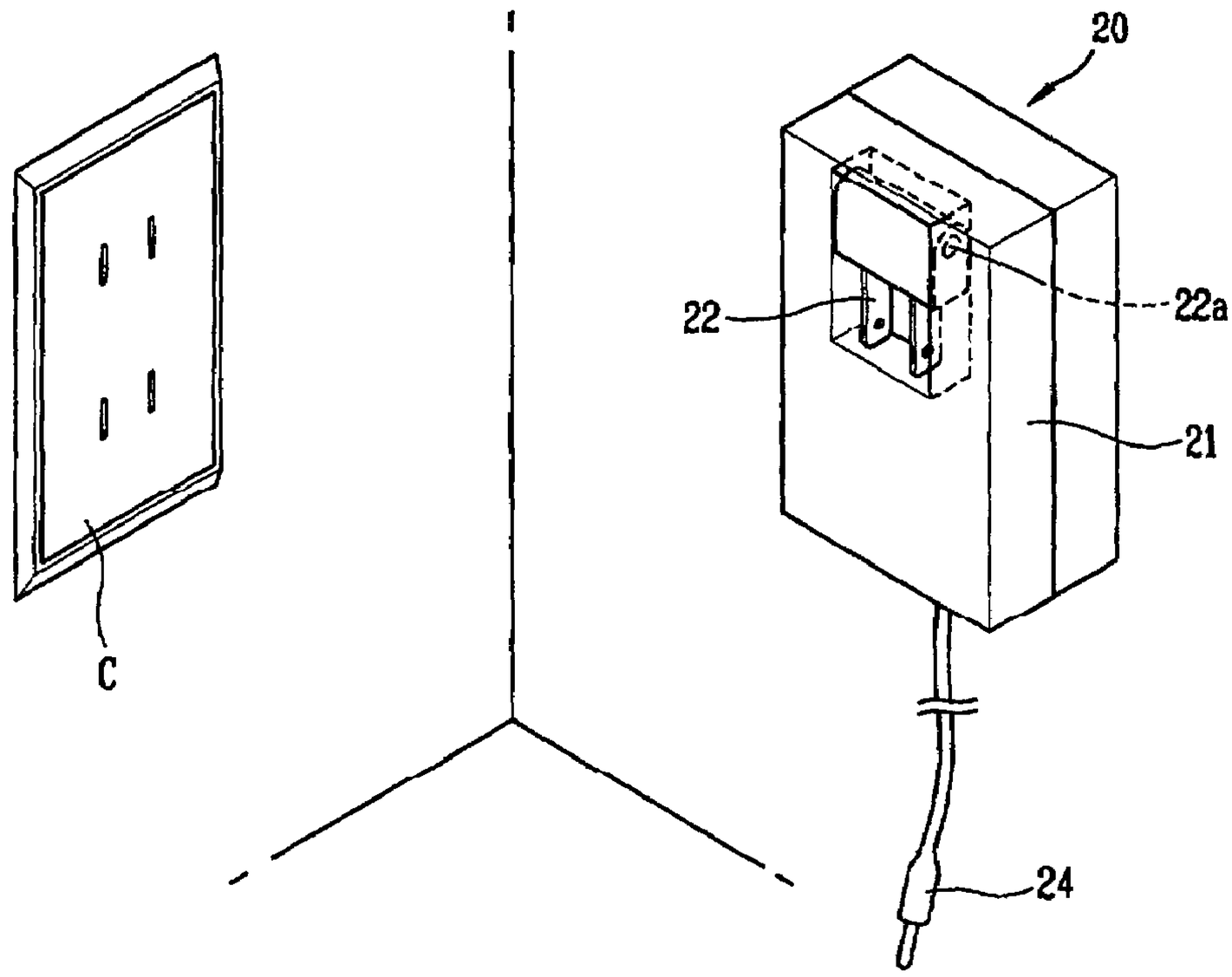


FIG. 2
RELATED ART

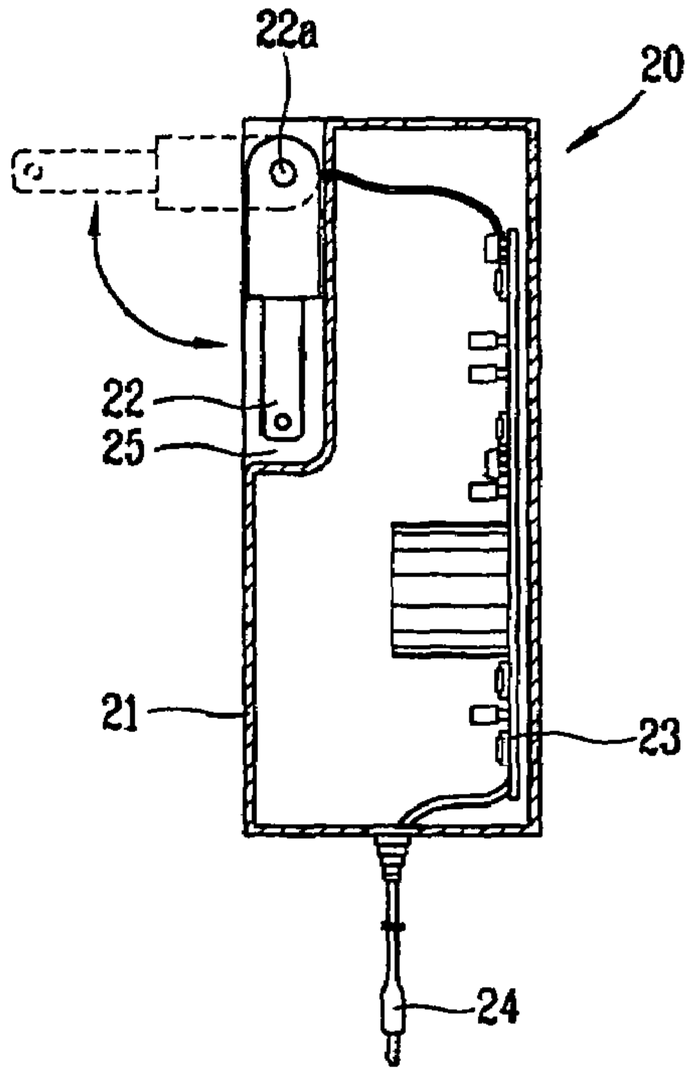


FIG. 3

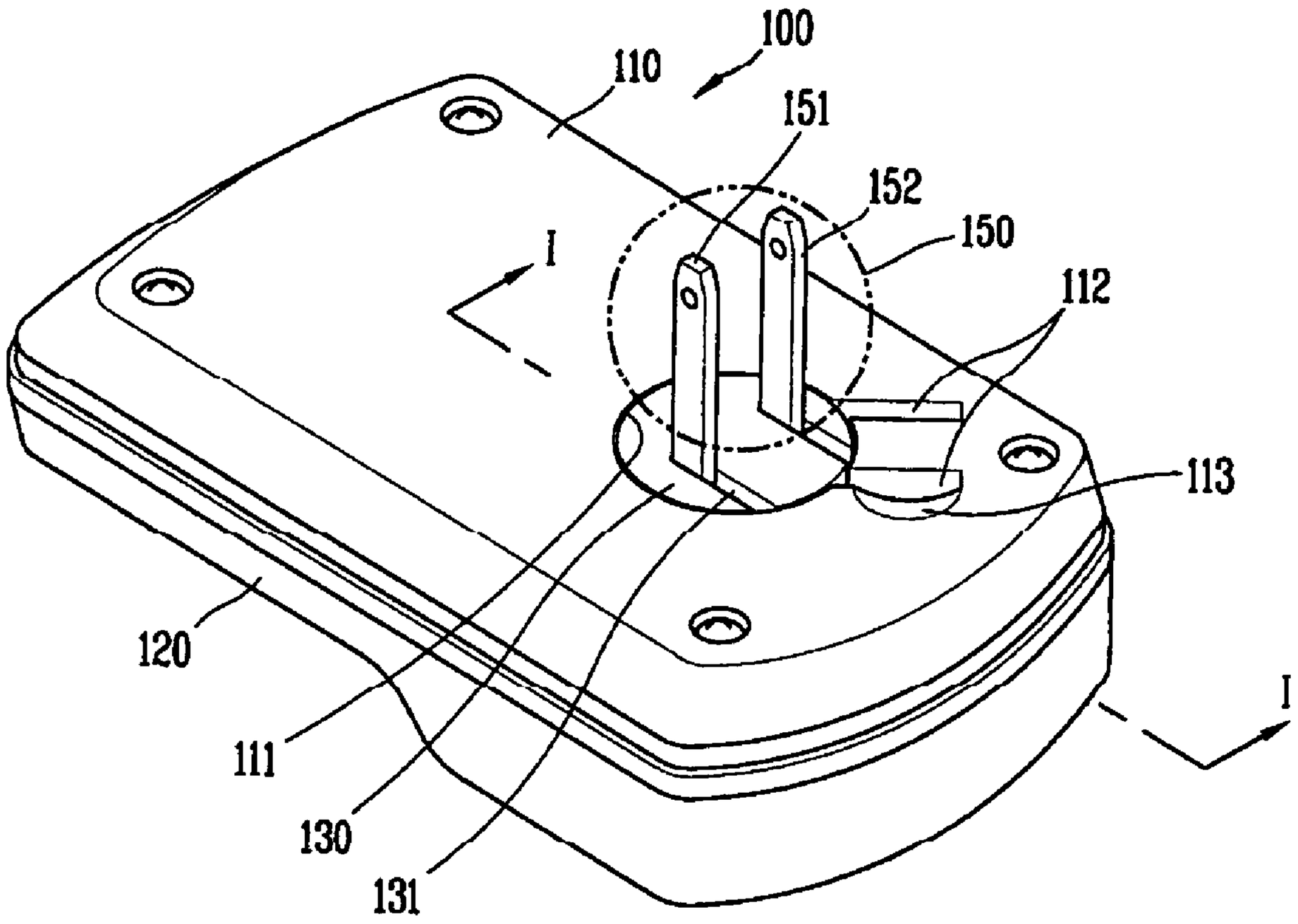


FIG. 4

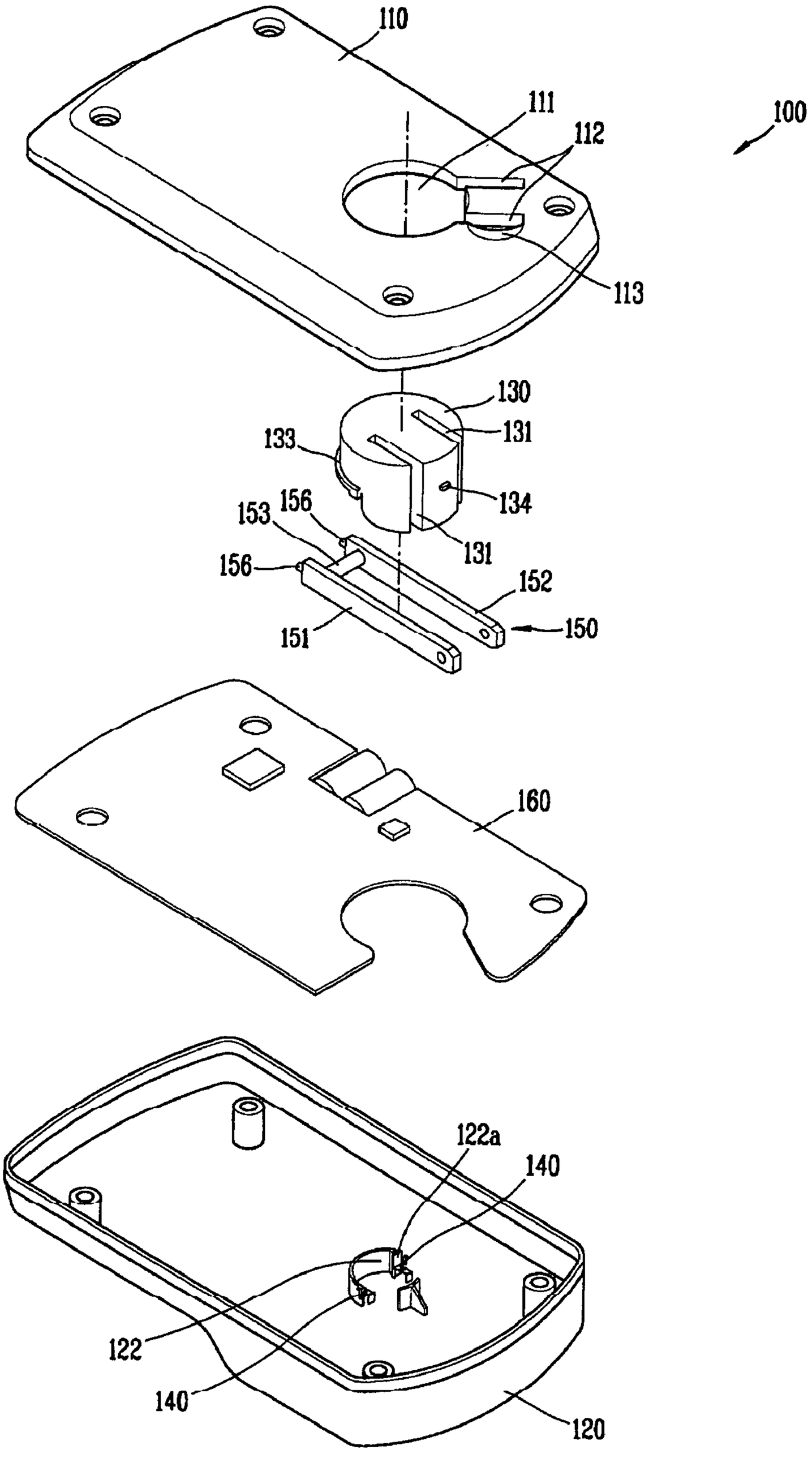

110
111
112
100
113
130
131
133
134
153
156
131
156
152
150
151
160
122a
140
122
140
120

FIG. 5

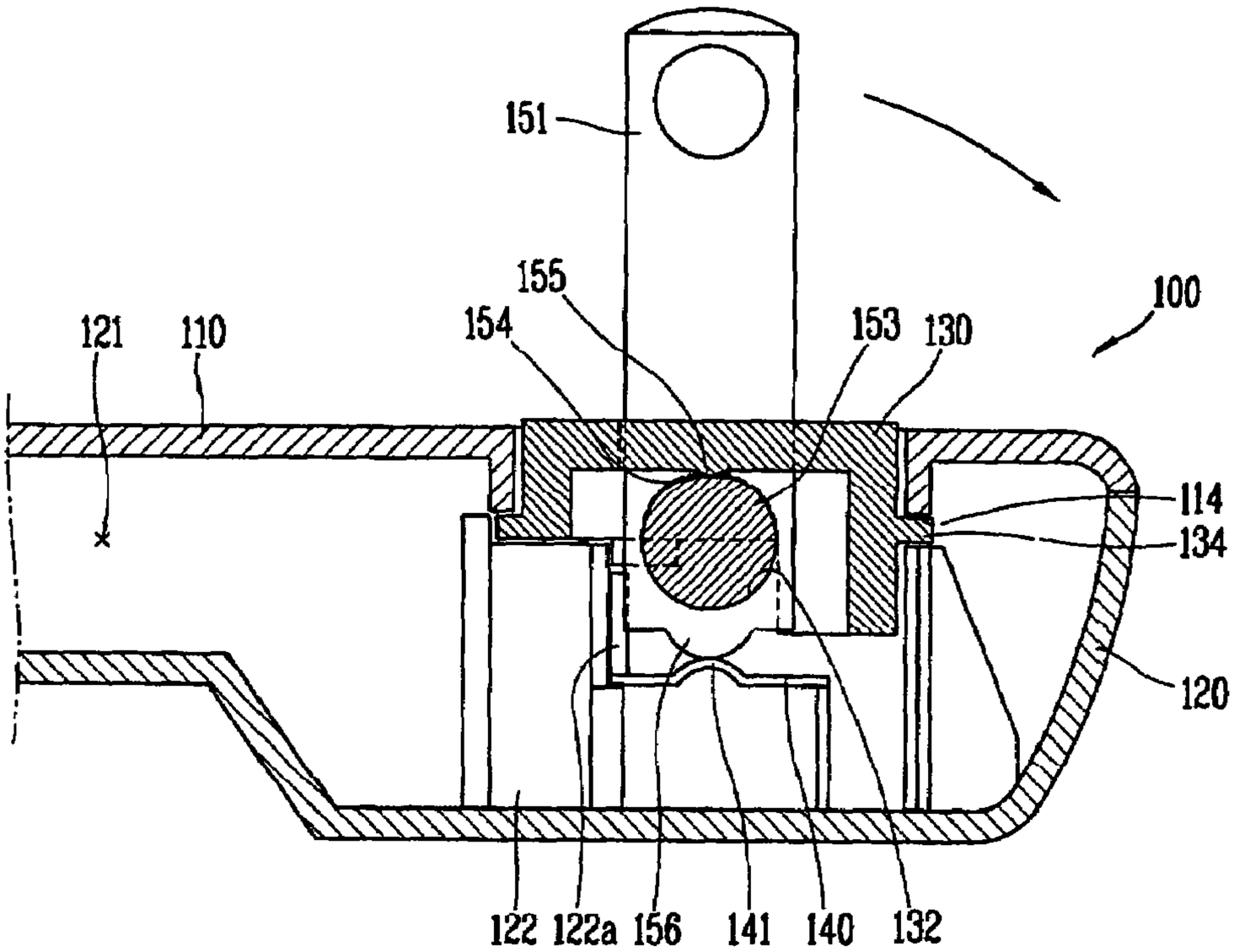

151
155
154
121
110
153
130
100
114
134
120
122
122a
156
141
140
132

FIG. 6

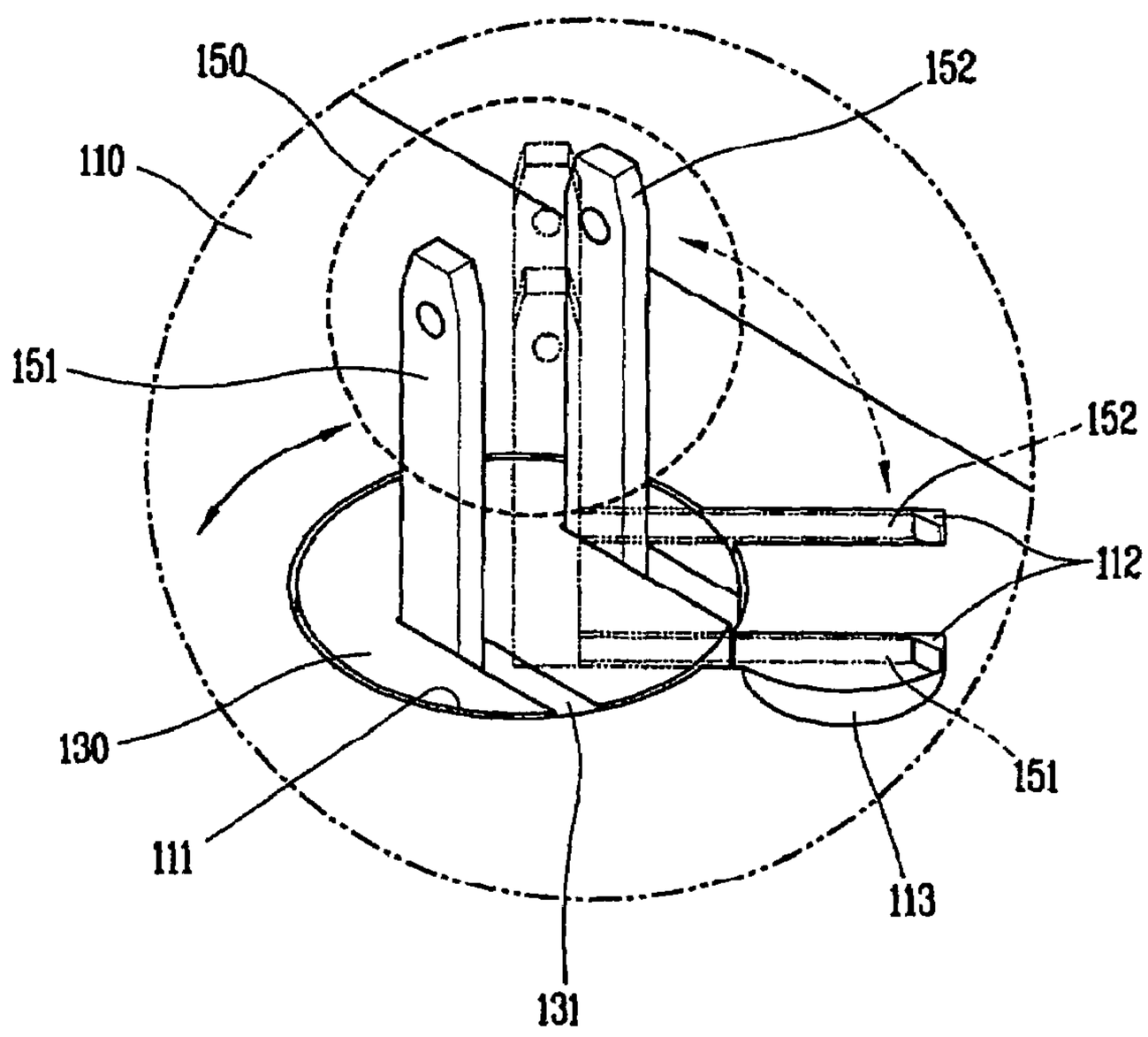

150
152
110
151
152
112
130
111
131
151
113

FIG. 7

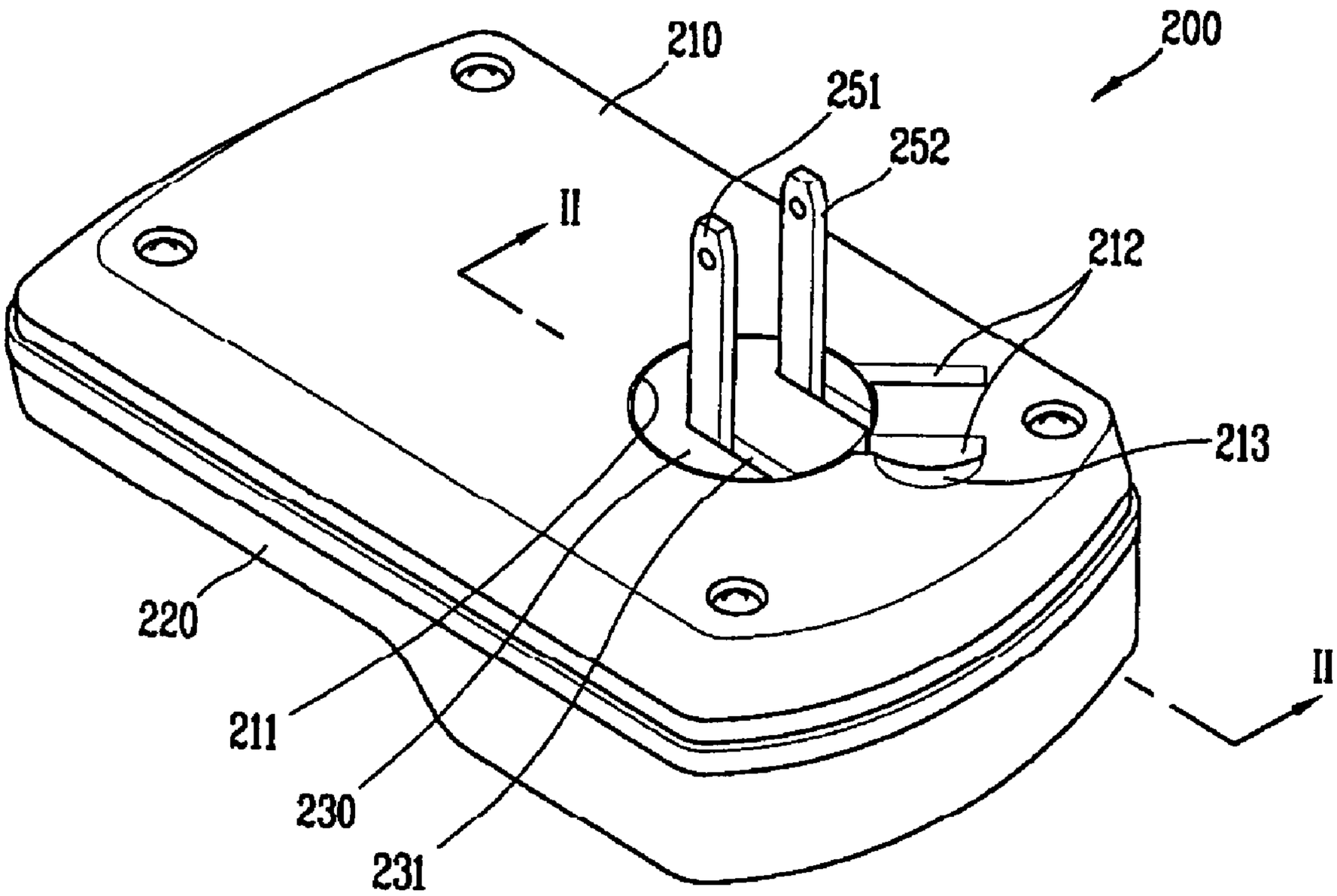


FIG. 8

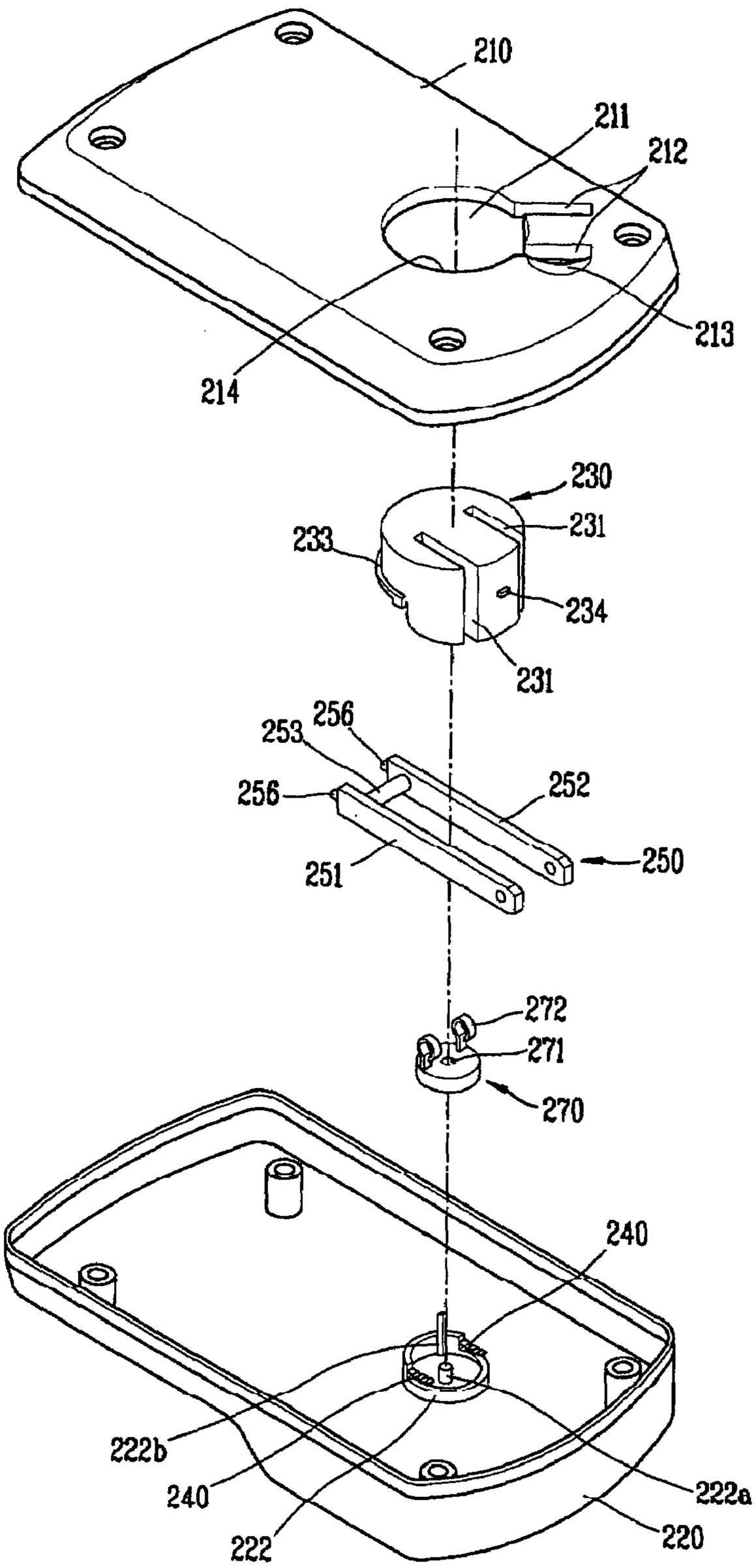

210
211
212
213
214
230
231
233
234
231
256
253
256
252
250
251
272
271
270
240
222b
240
222
222a
220

FIG. 9

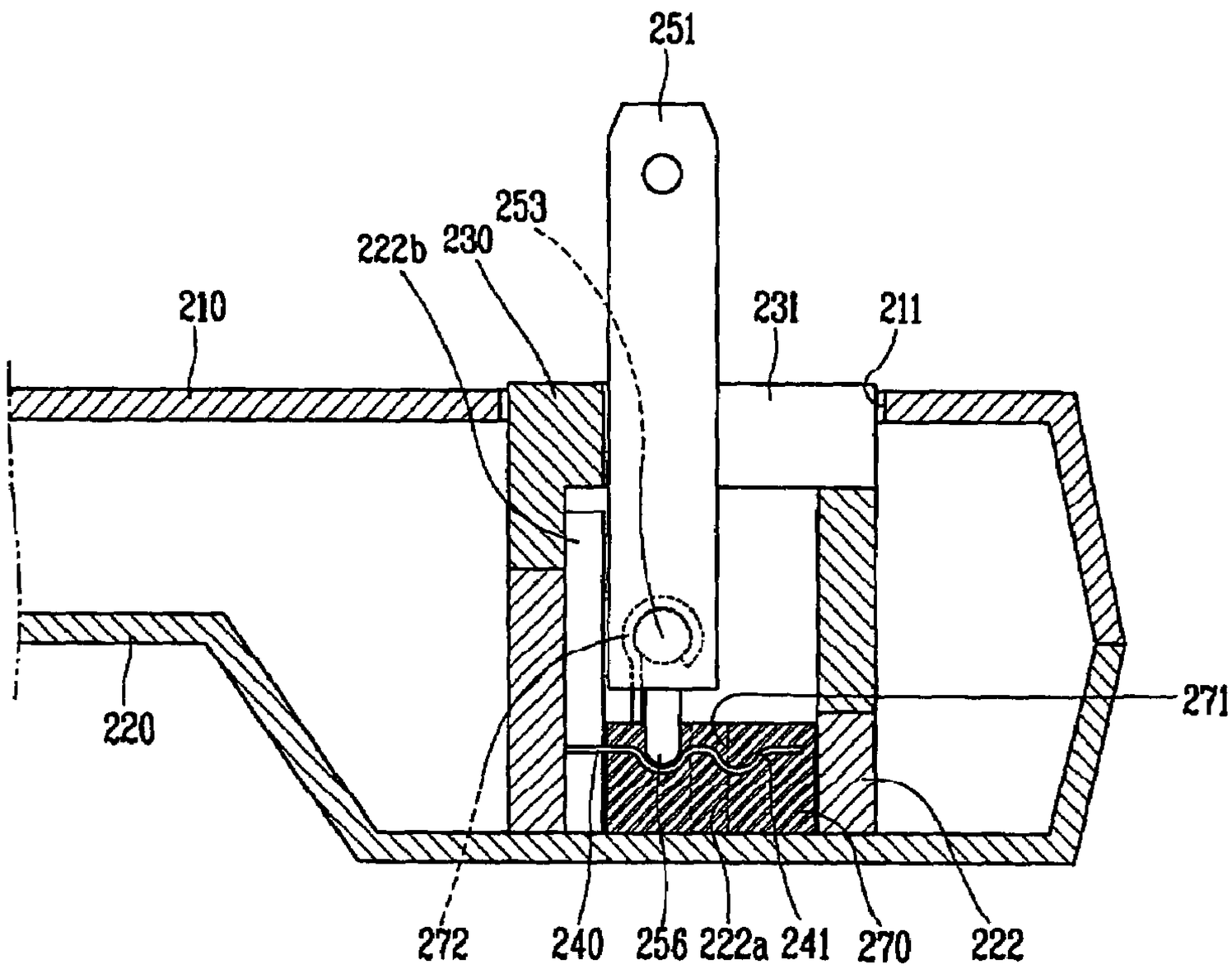
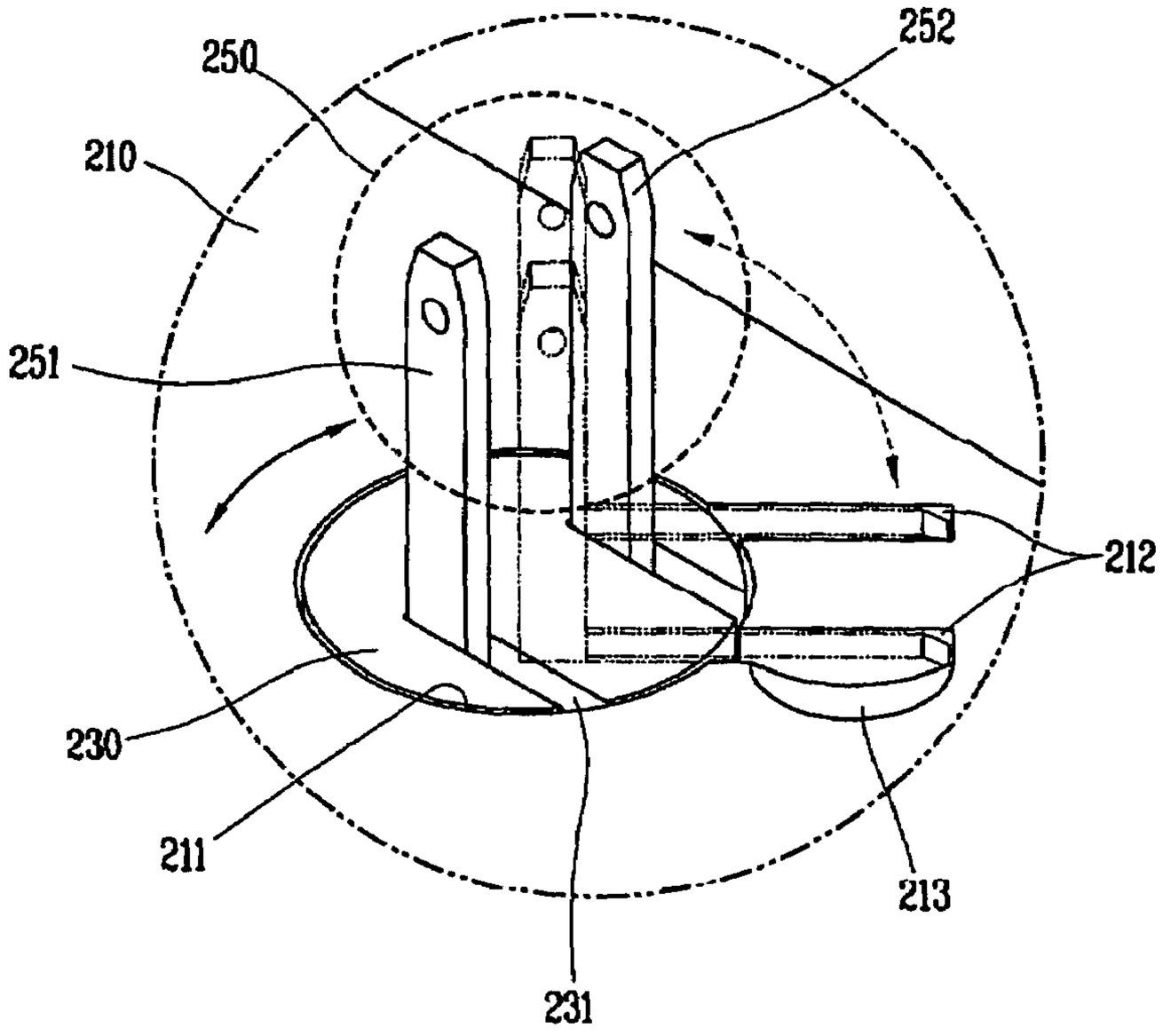

251
253
222b
230
210
231
211
220
271
272
240
256
222a
241
270
222

FIG. 10


250
252
210
251
212
230
211
213
231

APPARATUS FOR CONNECTING TO AN ELECTRICAL SOURCE

CROSS-REFERENCE TO RELATED APPLICATIONS

Pursuant to 35 U.S.C. § 119(a), this application claims the benefit of earlier filing date and right of priority to Korean Application No. 56560/2004, filed on Jul. 20, 2004; the contents of which are hereby incorporated by reference herein in their entirety.

FIELD OF THE INVENTION

The present invention relates to an apparatus for connecting electrical sources and more particularly, to an apparatus connecting electrical sources to an electrical device with an improved structure for folding and unfolding a plug terminal.

BACKGROUND OF THE INVENTION

FIG. **1** is a perspective view that illustrates a related art electrical connecting apparatus, such as a power adapter having a collapsible two-pronged plug. FIG. **2** is a section view that illustrates the related art electrical connecting apparatus. The related art electrical connecting apparatus includes a case **21**, and a plug terminal **22** installed at a front surface of the case **21**. The plug terminal **22** is rotatable about a hinge portion **22***a*.

Within the case **21**, a circuit board **23** couples to the plug terminal **22**. The circuit board **23** converts a high voltage into a low voltage. The plug terminal **22** may be connected to a power supply unit C, such as a wall mount electrical socket to receive the high voltage.

Extending out of the case **21**, an output terminal **24** connected to the circuit board **23** outputs the low voltage. The low voltage may be used to power an electronic device, not shown, such as a mobile communication terminal. Formed on the case **21**, a rectangular plug-receiving cavity **25** receives the plug terminal **22** in a folded position.

In the related art electrical connecting apparatus, the plug terminal **22** after an extended period of use becomes loose rotates in an undesirable direction. This causes inconvenience to the user when inserting the plug terminal into a wall socket.

Thus, there is a need for an improved electrical connecting apparatus that is more robust and provides advantages and more convenience to a user.

SUMMARY OF THE INVENTION

Features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

An object of the present invention is to provide an electrical connecting apparatus that provides simplified folding and unfolding of a plug terminal. Another object of the present invention is to provide simplified folding and unfolding of the plug terminal to improve a user's convenience. Another object of the present invention is to improve

reliability of an electrical connecting apparatus by maintaining firmness of the plug terminal after repeated folding and unfolding.

In one embodiment, an apparatus is disclosed for connecting a power supply to an electronic device. The apparatus comprises a first case having an insertion opening and a plurality of terminal-receiving grooves extending outwardly from an inner circumference of the insertion opening. A second case couples to the first case to form a receiving space. A rotary member is rotatably inserted in the insertion opening and having slots formed on at least one surface to align with the terminal-receiving grooves of the first case when the rotary member is turned in a first direction in a predetermined angle.

A plug terminal assembly installed in the rotary member. In a first state, the plug terminal assembly is positioned approximately vertically upward in relation with a top surface of the first case. In a second state, the plug terminal assembly collapses to an approximately horizontal position in relation to the top surface of the first case such that terminal ends of the plug terminal assembly are positioned in the terminal-receiving grooves when the rotary member is turned in the first direction in the predetermined angle.

In a second embodiment, a collapsible plug assembly is disclosed. The assembly comprises a first case having an insertion opening and a plurality of terminal-receiving grooves extending from an inner circumference of the insertion opening. A second case couples to the first case to form a receiving space. A boss portion is extended from inside the second case to correspond with the insertion opening. A rotary member is rotatably inserted in the insertion opening and having slots formed on at least one surface to align with the terminal-receiving grooves of the first case when the rotary member is turned in a first direction in a predetermined angle.

A plug terminal assembly is installed in the rotary member. In a first state, the plug terminal assembly is positioned approximately vertically upward in relation with a top surface of the first case. In a second state, the plug terminal assembly collapses to an approximately horizontal position in relation to the top surface of the first case such that terminal ends of the plug terminal assembly are positioned in the terminal-receiving grooves when the rotary member is turned in the first direction in the predetermined angle.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention. It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention. Features, elements, and aspects of the invention that are referenced by the same numerals in different figures represent the same, equivalent, or similar features, elements, or aspects in accordance with one or more embodiments.

FIG. **1** is a perspective view that illustrates an electrical connecting apparatus in accordance with the related art.

FIG. **2** is a sectional view that illustrates the electrical connecting apparatus in accordance with the related art.

FIG. **3** is a perspective view that illustrates an electrical connecting apparatus in accordance with one embodiment of the present invention.

FIG. **4** is an exploded perspective view of the electrical connecting apparatus of FIG. **3** in accordance with one embodiment of the present invention.

FIG. **5** is a sectional view taken along line I—I of FIG. **3**.

FIG. **6** is an enlarged perspective view that illustrates a plug terminal assembly of the electrical connecting apparatus in folded and unfolded states, in accordance with one embodiment of the present invention.

FIG. **7** is a perspective view that illustrates an electrical connecting apparatus in accordance with another embodiment of the present invention.

FIG. **8** is an exploded perspective view that illustrates the electrical connecting apparatus in accordance with another embodiment of the present invention.

FIG. **9** is a sectional view taken along line II—II of FIG. **7**.

FIG. **10** is an enlarged perspective view that illustrates a folded/unfolded state of a plug terminal assembly of the electrical connecting apparatus in accordance with another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

Referring to FIGS. **3** and **4**, the electrical connecting apparatus **100** comprises a first case **110**, a second case **120**, and a rotary member **130**. An insertion opening **111** for the rotary member **130** is provided proximal to a central portion of the first case **110**. A plurality of terminal-receiving grooves **112** extends from an inner circumference surface of the insertion opening **111**. The first case **110** couples to a second case **120** to form a receiving space therein. A boss portion **122** extends upward from the inner surface of second case **120**, as shown in FIG. **4**.

The boss portion **122** corresponds to the insertion opening **111**. A rotary member **130** is rotatably installed within the insertion opening **111** of the first case **110**. Slots **131** are disposed within the rotary member **130**, preferable parallel to each other. Slots **131** line up with the terminal-receiving grooves **112** when the rotary member is rotated in a first direction in a predetermined or specified angle.

Connection plates **140** installed at the boss portion **122** of the second case **120** connect to a printed circuit board **160**. A plug terminal assembly **150**, comprising for example a pair of elongated electric terminals, is rotatably installed at a bottom portion of the rotary member **130**.

In one embodiment, a first portion of the assembly **150**, when installed, contacts each of the connection plates **140**. A second portion of the assembly **150** penetrates the insertion opening **111** of the first case **110** for exposing the plug terminal assembly **150** outside of the first case **110**.

Referring to FIGS. **4** and **6**, a finger insertion groove **113** is preferably formed at the terminal-receiving grooves **112** to allow a user conveniently unfold the plug terminal assembly **150** when it is in a folded state. The finger insertion groove **113** is deep enough to allow for the tip of a user's finger to come in contact with the plug terminal assembly **150**, when it is in a folded state. In a preferred embodiment, the finger insertion groove **113** is approximately 10 mm wide.

Referring back to FIG. **4**, a flange **133** is disposed around an outer edge of the rotary member **130**. While inserted in the insertion opening **111**, the flange **133** prevents the rotary member **130** from unintentionally slipping out from the first case **110**.

Referring to FIG. **5**, inside the first case **110**, a stopping groove **114** is formed near the insertion opening **111**. A stopper **134** is formed at an outer circumferential surface of the rotary member **130**. The stopper **134** corresponds with the stopping groove **114**. When a user rotates the rotary member **130** to fold or unfold the plug terminal assembly **150**, a rotating angle of the rotary member **130** is restricted. Preferably, the rotary member **130** is restricted to a maximum predetermined angle. The plug terminal assembly **150** provides two elongated electric terminals: a first terminal **151** and a second terminal **152**. The first and second terminals **151**, **152** insert into the slots **131***a*, **131***b* of the rotary member **130**.

Referring to FIGS. **4** and **5**, a shaft **153**, formed of an insulation material, for example, connects the first terminal **151** with the second terminal **152**. The shaft can be rotatably inserted into a shaft groove **132** of the rotary member **130**. A groove **154** is formed in the middle of the shaft **153**. A protrusion **155** is formed at the rotary member **130**, which corresponds with the groove **154**.

In the unfolded state, when the protrusion **155** is inserted in the groove **154**, the plug terminal assembly **150** firmly maintains the unfolded state. First connection protrusions **156** are formed at a first end of the first and second terminals **151**, **152**. Second connection protrusions **141** are formed at each of the connection plates **140** corresponding to the first connection protrusions **156**.

In the unfolded state, the first connection protrusions **156** contact the second contact protrusions **141**. A second end of each of the first and second terminals **151**, **152** pass through the insertion opening **111** of the first case **110** to extend outside of the first case **110**. In the folded state, the first connection protrusions **156** of the first and second terminals **151**,**152** do not contact the second connection protrusions **141**. That is, the second end of each of the first and second terminals **151**,**152** is inserted in the terminal-receiving grooves **112**, respectively. As the rotary member **130** is rotated, each of the slots **131***a*, **131***b* of the rotary member **130** is aligned with a corresponding terminal-receiving groove **112**, thus, allowing the folding of the plug terminal assembly **150**.

Referring to FIGS. **4**–**6**, the procedure for folding and unfolding the plug terminal assembly **150** is herein described. As shown in FIG. **6**, a plug terminal assembly **150** is depicted as dotted lines in the folded state. To unfold the plug terminal assembly **150**, the user puts a finger in the finger insertion opening **113** and flips upward the first terminal **151**. In this example, because the shaft **153** is rotatably connected with the shaft groove **132**, the plug terminal assembly **150** rotates about the shaft **153** so that both the first and second terminals **151**, **152** extend approximately vertically upward in relation to outer surface of the first unit **110**.

When the plug terminal assembly **150** is completely rotated, the protrusion **155** is inserted in the groove **154**, thereby firmly maintaining the unfolded state of the plug terminal assembly **150**. As a user rotates the plug terminal assembly **150** in a clockwise direction, for example, the rotary member **130** rotates clockwise. The slots **131** of the rotary member **130** become distally located from the termi-

nal-receiving grooves **112** causing a contact to be maintained between the first contact protrusions **153** and the second contact protrusions **141**. In the unfolded state, a support portion **112** supports the plug terminal assembly **150**, thereby firmly maintaining the unfolded state.

To change the plug terminal assembly **150** from the unfolded to the folded state, the user rotates the plug terminal assembly **150** counterclockwise, for example. The rotary member **130** rotates in a counter-clockwise direction a result. The slots **131** of the rotary member **130** align with the terminal-receiving grooves **112**. In the folded state, the first contact protrusions **153** do not contact the second contact protrusions **141**. Consequently, when a user presses on the first terminal **151** or the second terminal **152**, the plug terminal assembly **150** rotates about the shaft **153** because the shaft **153** is rotatably inserted in the shaft groove **132** of the rotary member **130**. When the plug terminal assembly **150** is completely rotated, the first terminal **151** and the second terminal **152** are received in the terminal-receiving grooves **112**.

Referring to FIG. **7**, the electrical connecting apparatus **200** in accordance with another embodiment of the present invention comprises a first case **210**, a second case **220**, and a rotary member **230**. The first case **210** has an insertion opening **211** proximate to the center. In addition, the first case **210** has a plurality of terminal-receiving grooves **212** extending outward from the inner circumference of the insertion opening **211**. The first case **210** is coupled to the second case **220** to form a receiving space.

Referring to FIG. **8**, a boss portion **222**, in this example ring-shaped, extends from interior surface of the second case **220** to correspond with the insertion opening **211**. A rotary member **230** is rotatably installed within the insertion opening **211** of the first case **210**. Slots **231** are disposed within the rotary member **230** and correspond to the terminal-receiving grooves **212**. Connection plates **240** are installed at both sides of the boss portion **222** of the second case **220**. The connection plates **240** contact a printed circuit board **260** and a plug terminal assembly **250** inserted in the rotary member **230**.

One end (lower portion) of the rotary member **230** contacts each of the connection plates **240**. The other end (upper portion) of the rotary plate **230** passes through the insertion opening **211** of the first case **210** so as to pass through outside of the first case **210**. A terminal support member **270**, installed in the boss portion **222**, rotatably supports the plug terminal assembly **250**. Preferably, a finger insertion groove **213** is formed at the terminal-receiving groove **211** so that a user may conveniently fold or unfold the plug terminal assembly **250**.

As for a structure of the rotary member **230**, a flange **233** is formed around an outer circumference of the rotary member **230**. The flange **233** secures the rotary member **230** while rotatably inserted in the insertion opening **211** to the first case **210**. A stopping groove **214** is formed inside the first case **210** near the insertion opening **211**. At an outer circumferential surface of the rotary member **230**, a stopper **234** is formed to correspond with the stopping groove **214**. When a user rotates the rotary member **230** to fold or unfold the plug terminal assembly **250**, a rotating angle of the rotary member **230** is restricted, namely, the rotary member **230** may be rotated only up to a specified angle.

The plug terminal assembly **250** includes two terminals: a first terminal **251** and a second terminal **252**. The first terminal **251** and the second terminal **252** are inserted in the slots **231** of the rotary member **230**. A shaft **253** formed of an insulation material, for example, connects the first terminal **251** with the second terminal **252**. A connection protrusion **256** is formed at first end of each of the first and second terminals **251** and **252**. A plurality of connection grooves **241**, which are formed at each connection plate **240**, correspond to the connection protrusion **256**.

In the unfolded state of the plug terminal assembly **250**, the connection protrusions **256** of the first and second terminals **251** and **252** elastically contact the connection grooves **241**. Second ends of each of the first and second terminals **251**,**252** detachably insert into the insertion opening **211** to extend outside of the first case **210**.

In the folded state of the plug terminal assembly **250**, the contact protrusions **256** of the first and second terminals **251**, **252** do not contact the connection grooves **241**. In the folded state, the end portions of the first and second terminals **251**, **252** are inserted in the terminal-receiving grooves **212** of the first case **210**.

As a user rotates the rotary member **230**, each of the slots **231** of the rotary member **230** are selectively aligned with terminal-receiving grooves **212** of the first case **210**, thereby providing for folding of the plug terminal assembly **250**. A shaft **222***a* is preferably formed at the central location of the boss portion **222**. A shaft hole **271** is formed at the center of the terminal support member **270**, corresponding to the shaft **222***a*. Coupling rings **272** are formed at sides of the terminal support member **270**. Coupling rings **272** insert along the end of the shaft **253** of the plug terminal assembly **250**. A support portion **222***b* is formed at the boss portion **222**. The support portion **222***b* supports the unfolded state of the plug terminal assembly **250**.

Referring to FIGS. **9** and **10**, operation of the electrical connecting apparatus in accordance with an embodiment of the present invention is disclosed. As shown, a dotted line in FIG. **10** depicts the plug terminal assembly **250** in a folded state. To move the plug terminal assembly **250** from the folded state to the unfolded state, a user inserts his/her finger in the finger insertion opening **213** and pulls the first terminal **251** in an upward fashion. Because the shaft **253** is rotatably inserted in the rings **272** of the terminal support member **270**, the plug terminal assembly **250** rotates about the shaft **253**.

When the user rotates the plug terminal assembly **250** in a clockwise direction, for example, the rotary member **230** and the terminal support member **270** rotate clockwise. Afterwards, the slots **231** of the rotary member **230** from the terminal-receiving grooves **212** elastically contact the contact protrusions **256** while being secured within the contact grooves **241**. The support portion **222***b*, which is formed at the boss portion **222**, and the contact grooves **241**, serve to firmly maintain the unfolded state of the plug terminal assembly **250**.

To change to the folded state from the unfolded state, which is depicted in FIG. **10** as a solid line, a user rotates the plug terminal assembly **250** counterclockwise, for example, to rotate the rotary member **230** in a counterclockwise direction. The slots **231** of the rotary member **230** are linearly aligned with the terminal-receiving grooves **212**. In the folded state, the contact protrusions **256** are maintained to prevent contact the terminal-receiving grooves **212**.

If the user presses down on the first terminal **251** or the second terminal **252**, the plug terminal assembly **250** is rotated about the shaft **253** because the shaft **253** is rotatably inserted in the rings **271** of the terminal support member **270**. When the plug terminal assembly **250** is completely rotated, the first terminal **251** or the second terminal **252** is received in the terminal-receiving grooves **212**. As the first terminal **251** or the second terminal **252** is received in the

terminal-receiving grooves **212**, the electrical connecting apparatus **200** can be simply and easily maintained.

As described, the present invention the folding and unfolding of the plug terminal is very easily performed. In addition, the present invention provides for the unfolded state of the plug terminal to be firmly maintained. This improvement increases a user's convenience and reliability when utilizing a plug terminal.

As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalence of such metes and bounds are therefore intended to be embraced by the appended claims.

What is claimed is:

1. An apparatus for connecting a power supply to an electronic device, the apparatus comprising:

a first case having an insertion opening and a plurality of terminal-receiving grooves extending outwardly from an inner circumference of the insertion opening;

a second case coupled to the first case to form a receiving space;

a rotary member rotatably inserted in the insertion opening and having slots formed on at least one surface to align with the terminal-receiving grooves of the first case when the rotary member is turned in a first direction in a predetermined angle; and

a plug terminal assembly installed in the rotary member so that in a first state the plug terminal assembly is positioned approximately vertically upward in relation with a top surface of the first case, and in a second state the plug terminal assembly collapses to an approximately horizontal position in relation to the top surface of the first case such that terminal ends of the plug terminal assembly are positioned in the terminal-receiving grooves when the rotary member is turned in the first direction in the predetermined angle.

2. The apparatus of claim **1**, wherein the plug terminal assembly has first and second ends, wherein in the first state the first end electrically connects to the power supply.

3. The apparatus of claim **1**, wherein the second case further comprises a boss portion extending upward from an inner surface of the second case in relationship with the insertion opening, wherein the boss portion and the insertion opening are co-centric.

4. The apparatus of claim **3**, further comprising connection plates installed at the boss portion.

5. The apparatus of claim **1**, wherein a finger insertion groove is formed proximal to at least one of the terminal-receiving grooves.

6. The apparatus of claim **1**, wherein the plug terminal assembly comprises:

at least two elongated electric terminals each having a terminal end collapsible into the slots of the rotary member in the second state; and

a shaft connecting the at least two elongated electric terminals and rotatably inserted in a shaft groove of the rotary member.

7. The apparatus of claim **6**, wherein:

a groove is formed proximal to a middle portion of the shaft, and

a protrusion is formed at the rotary member to correspond to the groove to provide a stop to prevent further rotation of the rotary member.

8. The apparatus of claim **6**, further comprising:

a boss portion disposed on the inside of the second case;

connection plates installed at the boss portion;

a first connection protrusion formed at a first end of the each of the at least two elongated

electric terminals opposite the terminal ends, and

a second connection protrusion formed at each of the connection plates to correspond to the first connection protrusion of the each of the at least two elongated electric terminals.

9. The apparatus of claim **8**, wherein if the plug terminal assembly is in the first state, the first connection protrusion of the each of the at least two elongated electric terminals comes in contact with the second connection protrusion of the each of the connection plates.

10. The apparatus of claim **8**, wherein if the plug terminal assembly is in the second state, the each of the at least two elongated electric terminals partially collapses in the insertion opening of the first case.

11. The apparatus of claim **1**, wherein the first case further comprises:

a stopping groove formed inside the first case near the insertion opening,

a stopper is formed at an outer circumferential surface of the rotary member to correspond to the stopping groove to restrict an angle of rotation of the rotary member.

12. The apparatus of claim **1**, further comprising a flange formed around an outer circumference of the rotary member.

13. A collapsible plug assembly comprising:

a first case having an insertion opening and a plurality of terminal-receiving grooves extending from an inner circumference of the insertion opening;

a second case coupled to the first case to form a receiving space;

a boss portion extended from inside the second case to correspond with the insertion opening;

a rotary member rotatably inserted in the insertion opening and having slots formed on at least one surface to align with the terminal-receiving grooves of the first case when the rotary member is turned in a first direction in a predetermined angle; and

a plug terminal assembly installed in the rotary member so that in a first state the plug terminal assembly is positioned approximately vertically upward in relation with a top surface of the first case, and in a second state the plug terminal assembly collapses to an approximately horizontal position in relation to the top surface of the first case such that terminal ends of the plug terminal assembly are positioned in the terminal-receiving grooves when the rotary member is turned in the first direction in the predetermined angle.

14. The apparatus of claim **13**, wherein the plug terminal assembly has first and second ends, wherein in the first state the first end electrically connects to the power supply.

15. The apparatus of claim **13**, further comprising connection plates installed at both sides of the boss portion and connected to a printed circuit board.

16. The apparatus of claim **13**, wherein a finger insertion groove is formed proximal to at least one of the terminal-receiving grooves.

17. The apparatus of claim **13**, further comprising a terminal support member installed within the boss portion to rotatably support the plug terminal assembly.

18. The apparatus of claim 13, wherein the plug terminal assembly comprises:

at least two elongated electric terminals each having a terminal end collapsible into the slots of the rotary member in the second state; and

a shaft connecting the at least two elongated electric terminals and rotatably inserted in a shaft groove of the rotary member.

19. The apparatus of claim 18, wherein:

a groove is formed proximal to a middle portion of the shaft, and

a protrusion is formed at the rotary member to correspond to the groove to provide a stop to prevent further rotation of the rotary member.

20. The apparatus of claim 18, further comprising:

connection plates installed at the boss portion;

a first connection protrusion formed at a first end of the each of the at least two elongated electric terminals opposite the terminal ends, and

a second connection protrusion formed at each of the connection plates to correspond to the first connection protrusion of each of the at least two elongated electric terminals.

21. The apparatus of claim 20, wherein if the plug terminal assembly is in the first state, the first connection protrusion of the each of the at least two elongated electric terminals comes in contact with the second connection protrusion of the each of the connection plates.

22. The apparatus of claim 20, wherein if the plug terminal assembly is in the second state, the each of the at least tow elongated electric terminals partially collapses in the insertion opening of the first case.

23. The apparatus of claim 13, further comprising:

a stopping groove formed inside the first case near the insertion opening, and

a stopper formed at an outer circumferential surface of the rotary member to correspond with the stopping groove so that a rotation angle of the rotary member is restricted.

24. The apparatus of claim 13, further comprising a flange formed around an outer circumference of the rotary member.

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